Space Weather Technical Forecast

Issued on Thursday, 03 November 2022 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storms from later on the 3rd November. Likelihood of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours. The largest regions on the disc, AR3131 and AR3135, have both been stable with only minor changes. AR3136 has evolved relatively rapidly with developing complexity but shows some signs of stabilising. The remaining regions are simple and small, presenting very little risk of significant flares at present. No Earth directed CMEs have been identified.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, has been steady for much of the period, averaging between 400-500km/s until 02/0400UTC, after which the speed increased slightly to around 475km/s until 02/0800UTC. There has been a more marked and sustained increase since 02/1200UTC into elevated levels, rising to a peak of 600km/s at 02/2347UTC. Density was mainly below average, but with a steep rise to average and then above average values from 02/1000UTC. Total magnetic field strength was weak, but increased steadily towards moderate values from 02/0600UTC, reaching 9nT by the end of the period. The north-south component, Bz, has varied weakly, with a negative bias through much of the period, then a sharp negative peak of -7nT at 02/1227UTC before returning to values closer to -1nT. Phi angle was mainly positive (Away from the Sun) with brief transitions into the negative sector. Geomagnetic activity was Quiet to Active.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 has been at moderate or high levels on a diurnal cycle, with a peak of 6.47e3 at 02/1500UTC before reducing slightly. Electron fluence levels have increased above the Active threshold with a peak value of 1.09e8 integrated pfu observed at 03/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with a slight chance of isolated Moderate activity as further active regions are due to rotate onto the visible disc.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. The Earth is under the influence of a high speed stream from coronal hole 38. This is due to subside somewhat early on 3rd November, followed by an anticipated connection to the high speed stream from coronal hole 39, late on the 3rd into the 4th of November. This feature is currently forecast to produce speeds in the region of 600-650km/s. Geomagnetic activity will be mainly Quiet to Unsettled through much of the period, but with a risk of Active on 3rd November and Active or G1/Minor Storms from late on the 3rd into the 4th of November.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be at moderate to high levels through the

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period. The associated 24 hour electron fluence is expected to continue close to or just above the Active (1e8 integrated pfu) threshold.

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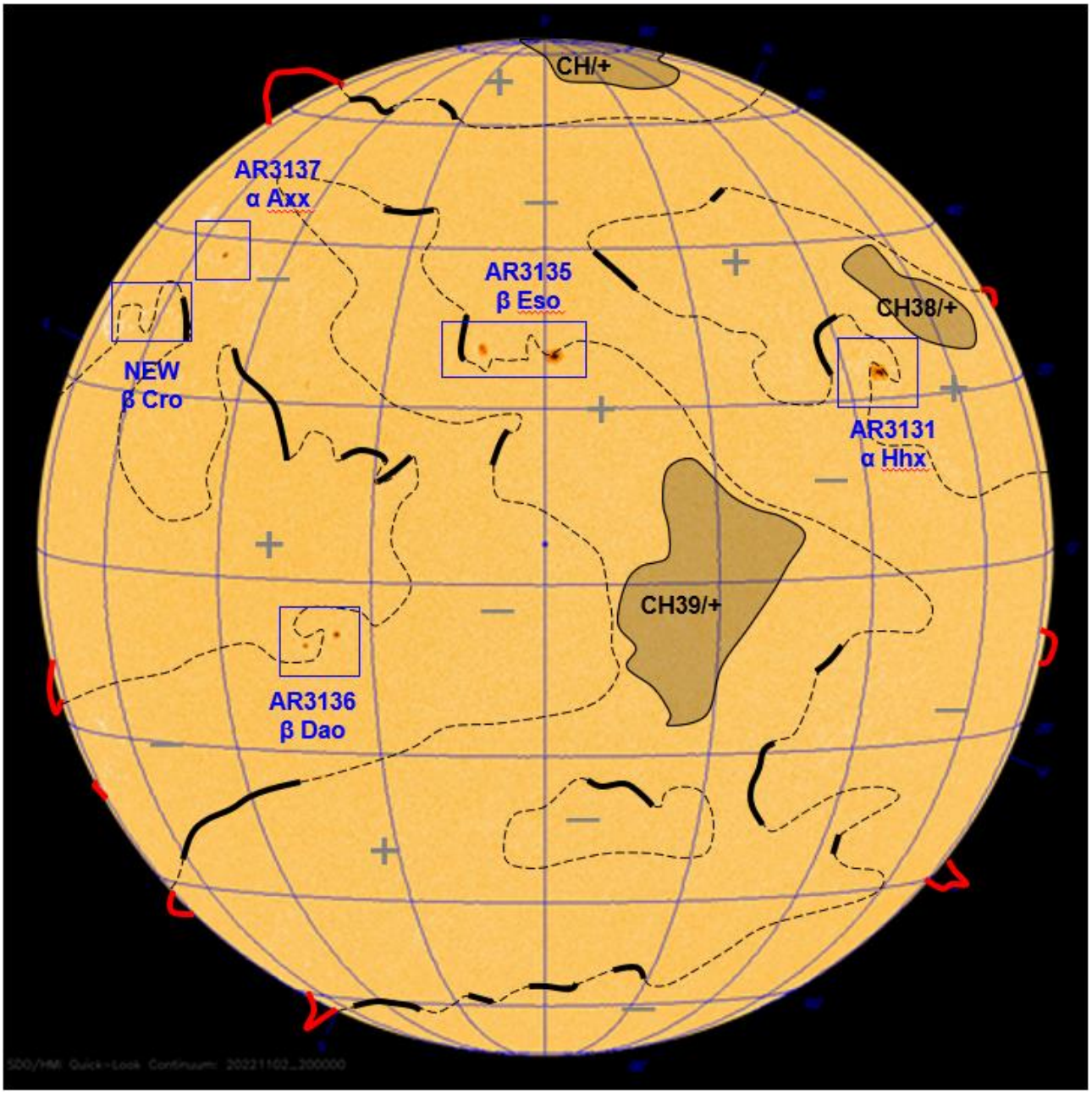
Figure 1. Solar Analysis Valid 02/2000.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently forecast.

Earth appears to be currently connected to the high speed stream from coronal hole 38, with speeds looking to peak around 550-600km/s based on observations from STEREO A and current values. This appears to be a delayed onset based on estimates of the solar wind speed for the previous rotation with a possible weak CME effect complicating the arrival. The winds associated with this feature are expected to ease somewhat into the 3rd but a second, and likely stronger high speed stream from coronal hole 39 then due to connect with Earth later on the 3rd November. Speeds from this feature are expected to be in the range 600-650km/s, though STEREO A is providing only limited data. On the last rotation speeds from this coronal hole reached close to 500km/s, but the coronal hole has undergone some changes in this rotation, speeding up and becoming more pronounced.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active intervals early on the 3rd November. The onset of the next high speed stream late in the day is expected to lead to a chance of Active or G1/Minor Storm intervals, with this risk slowly decreasing through the following two days with a return to Quiet levels by the 6th November. Based on the strength of the hole, there is a risk of further G1/Minor Storm intervals in any sustained periods of negative Bz.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	40	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Planetary K Index

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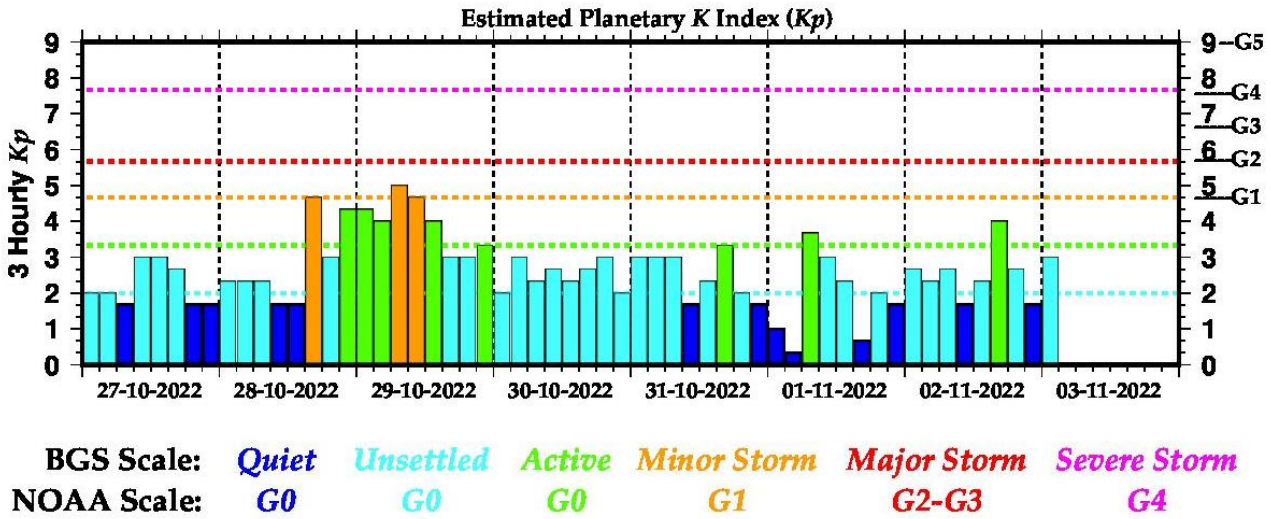
Met Office Space Weather Technical Forecast



BGS Scale:	Quiet	Unsettled	Active	Minor Storm	Major Storm	Severe Storm
NOAA Scale:	G0	G0	G0	G1	G2-G3	G4

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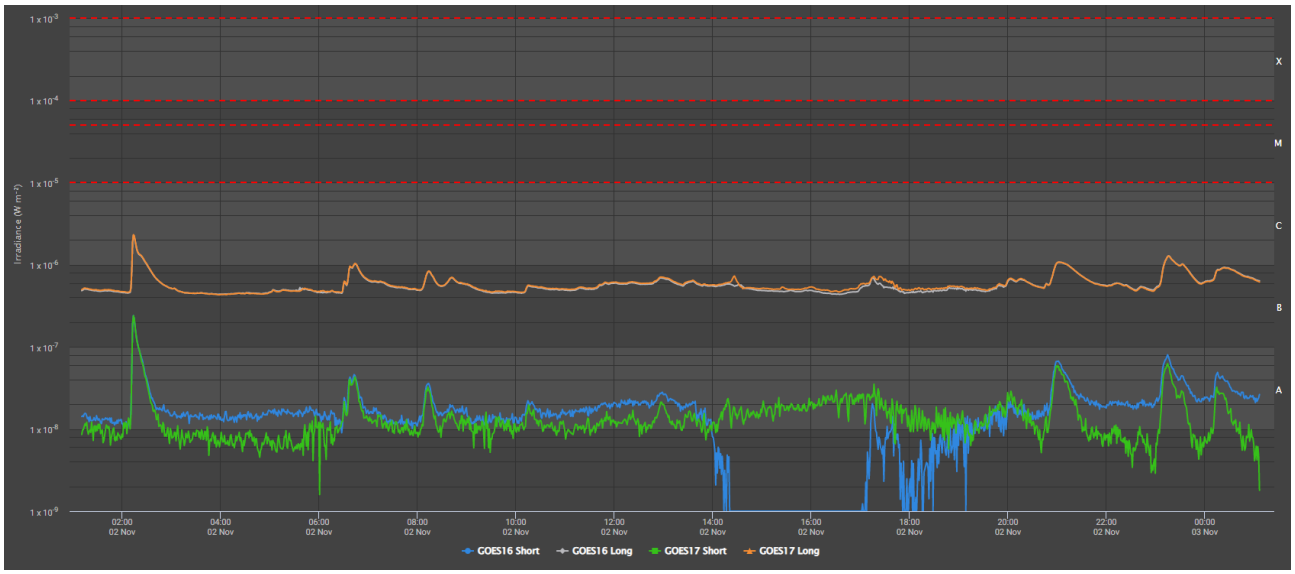
Radio Blackouts - X-Ray Flares:

There are five sunspot regions on the visible disc. The two largest of these, AR3131 and AR3135 appear mature and stable. AR3136 has evolved relatively rapidly with developing complexity but shows some signs of stabilising, this could still present a significant flare risk later in the period, with the remaining regions currently on the disk appearing small and weak. Farside data suggests that a number of significant active regions could rotate into the visible disc over the next four days, including ex-AR3122 which was a large, active sunspot on the previous rotation.

Solar activity is expected to be mainly Low or Very Low, but with a slight chance of Moderate activity throughout.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES17 X-Ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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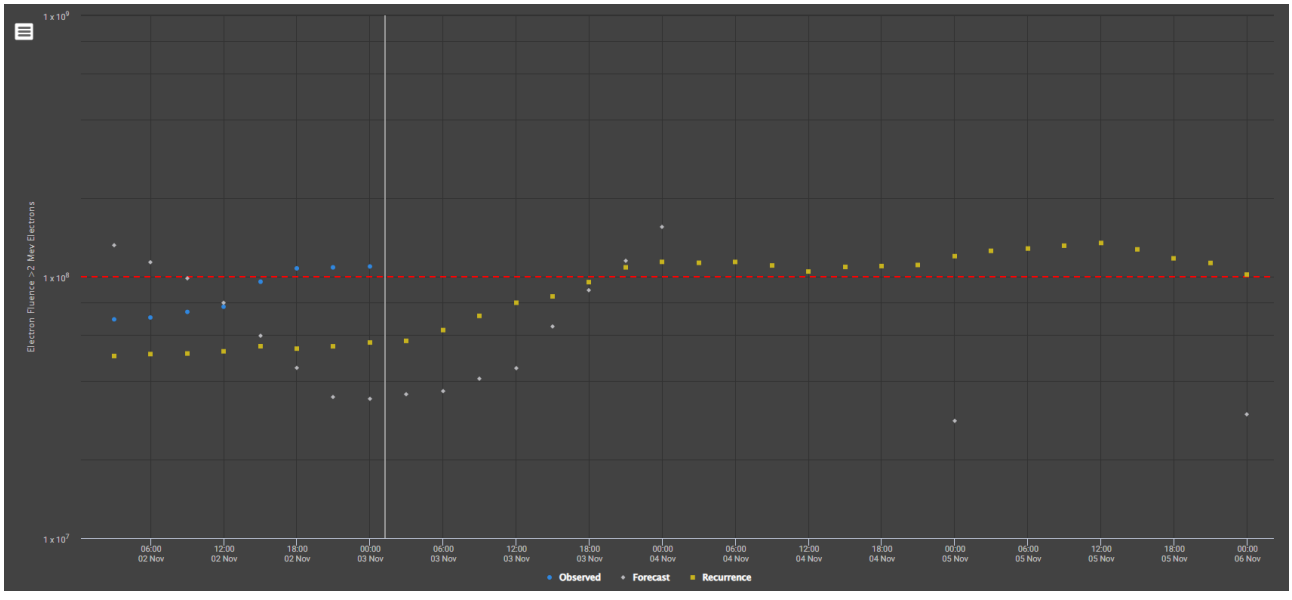
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently oscillating through moderate to high levels on a diurnal cycle. This pattern is expected to continue through the period, based on electron belt models with the radiation belts receiving a feed of electrons from recent high speed streams. There is a likelihood that the onset of a high speed stream either late on the 3rd November could be strong enough to distort the belts out of their natural orbits and lead to a dip in the flux, with a sharp recovery as the belts relax later in the period as the potential strong solar wind eases.

Electron fluence has followed an upward trend after falling just below the Active threshold in the last 24 hours. The longevity of this trend is uncertain, but there remains a continued risk of the fluence exceeding the Active threshold over the next four days in the high electron flux environment.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	70	50	50	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC electron fluence observations (blue) and REFM model output



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